# SCREENING OF *STRIGA HERMONTHICA* SEED GERMINATION STIMULANTS FROM NON – HOST CROPS (SOYABEAN, COWPEA AND GROUNDNUTS) FOR CONTROL EFFICACY.

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**Abstract**

*Striga hermonthica* (Del.) benth is a severe parasite on sorghum and a limiting factor in achieving optimum sorghum yields in infected areas in Africa. The parasite seeds are stimulated to germinate by root exudates from the host and non-host plants. This screen house study evaluated the *Striga hermonthica* seeds germination stimulants from three non-host crop (soyabean, cowpea and groundnut) for control efficacy. Results in the 2013 and 2014 combined analysis showed that soyabean variety TGX1019-2EB, cowpea varieties IT04K-217-5 and IT04K-333-2 and groundnut variety Chico significantly ($P \leq 0.05$) delayed *Striga* emergence than other varieties. Fewer *Striga* shoots was observed in soyabean variety TGX1448-2E and cowpea variety IT04K-217-5 at 8 WAS. But groundnut variety RMP-91 at 6 WAS rather showed fewer *Striga* count than other varieties. Sorghum grain yield was significantly ($p \geq 0.05$) higher in soyabean variety TGX1448-2E, cowpea variety IT04K-339-1and groundnut variety RMP-91 compared to other varieties. It was concluded that *Striga* control and sorghum grain yield could be achieve if the above trap crops are use in intercropping system.

**Keyword**: Trap crops, stimulant exudates, *Striga* suicidal germination.

## INTRODUCTION

*Striga* are generally native to semi-arid tropical areas of Africa, but have been recorded in more than 40 countries (Ejeta, 2007; vasey et al, 2005).The most ubiquitous and devastating species is *Striga hermonthica*. Occurrences of *Striga hermonthica* have also been reported from south-east Africa. *Striga hermonthica* is particularly harmful to sorghum, maize and millet, but is also increasingly being found in sugarcane and rice fields (Atera and Itoh, 2011). The problem of *Striga* species is more wide spread and serious in areas where both fertility and rainfall are low. *Striga* affects the life of more than 100 million people in Africa and causes economic damage equivalent to approximately 1 billion US dollar per year (Labrada, 2008; waruru, 2013).

The existence of ecotypes of *Striga hermonthica* and host species of these ecotypes requires the use of complimentary control methods. Host – parasites relationships should be understood fully to appreciate the effect of multiple cropping as well as the impact of crop rotations that involve the use of trap crops, which stimulates *Striga hermonthica* seed to germinate but are not parasitized. Resistant sorghum varieties intercropped with some trap crops such as soyabean, cowpea and groundnut selected for high *Striga* seeds germination stimulant should be the most long-term approach. Most of these trap crops are being grown by farmers in *Striga hermonthica* infested areas. In order to solve *Striga* problems in small scale agriculture, a system that would improve soil fertility to increase yield as well as reduce *Striga* infestation will be of double advantage. Screening and evaluation of stimulants from different varieties of three trap crops (Ten soyabean, cowpea and groundnut each) was evaluated in this research and cultivars with high concentration of *Striga hermonthica* germination stimulants recommended for farmers to be use in intercropping with sorghum to control *Striga*.

## MATERIALS AND METHOD

A trial screening the *Striga hermonthica* seed germination stimulants from three non-host crops (soyabean, cowpea and groundnut) was conducted at Federal University of Technology Minna Research Farm (09°3´N and 06°28´E) in 2013 and 2014 cropping season. Ten varieties each of soyabean, cowpea and groundnut was screened for the ability of their root exudates to stimulate *Striga* suicidal germination. Polybags filled with 20g of sterilized soil and inoculated with *Striga* Seeds at three levels inoculation rate (0, 2.5 and 5g) was used to plant the ten varieties of each soyabean, cowpea and groundnut. After harvesting the trap crops, two sorghum varieties, ICSV1002 resistance and susceptible local varieties were sown and monitored and watered regularly in the same Polybags. The sorghum varieties were repeatedly sown again the following year as done in previous year. Data collected on sorghum were; Days to *Striga* emergence, Striga count at 6 and 8 WAS per stand of sorghum, plant height at 10 and 14 WAS, 1000 grain weight and grain yield. Data were subjected to analysis of variance using computer software genstat (2010). Statistically differences between variable means were compared using least significant difference < ($P \leq 0.05$).

## RESULTS

There were significant ($p < 0.05$) difference in the combined effect of years on days to first *Striga* emergence, *Striga* count and plant height at 6 WAS (Table 1). The year 2014 significantly ($p < 0.05$) delayed *Striga* emergence and produced taller plant height than 2013. *Striga* count was fewer in 2013 than 2014 at 6 WAS.

The sorghum resistant variety ICSV 1002 significantly ($p < 0.05$) supported fewer *Striga* count, produced taller plant height and higher grain yield throughout the samply periods than local variety in both 2013 and 2014 combined (Table 1).

The 2013 and 2014 combined analysis on effect of screened soyabean varieties on sorghum shows that all the parameters were significantly ($p < 0.05$) different. soyabean variety TGX 1019-2EB delayed *Striga* emergence compared to other varieties (Table 1) varieties TGX 1990-45F and TGX 1448-2E supported fewer *Striga* count at 6 and 8 WAS respectively (Table 1) .Taller plant height was recorded in soyabean variety TGX1448-2E throughout the samply periods (6 and 8 WAS) higher grain yield was also observed in variety TGX 1448-2E (Table 1).

Combine analysis on effect of screened soyabean varieties on sorghum shows that 2.5 g *Striga* inoculation level delayed *Striga* emergence, supported fewer *Striga* count at 6 and 8 WAS compared to other *Striga* level (Table 1). While 0 g *Striga* level produced taller plant height throughout the samply periods (6 and 8 WAS) and high grain yield (Table 1).

The combined analysis for 2013 and 2014 interaction effect of year, sorghum and soyabean varieties screened were significant ( $p< 0.05$) in *Striga* count at 6

WAS and plant height at 8 WAS. All other parameter was not significantly different (Table 2).

The resistant sorghum variety ICSV 1002 in Polybags containing soyabean variety TGX 1448-2E in 2013 supported fewer striga count at 6 WAS compared to other varieties in both years. Taller plant height was produced in 2014 in resistant sorghum variety ICSV 1002 in Polybags containing soyabean varieties TGX 1448-2E and TGX 1019-2EB compared to other varieties in both years (Table 2).

**Table 1: 2013 and 2014 Combine effect of soyabean varieties screened on sorghum**

| Years | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000W | GY |
|---|---|---|---|---|---|---|---|
| 2013 | 38.20 | 4.11 | 6.36 | 25.3 | 42.4 | 13.20 | 318.1 |
| 2014 | 38.30 | 6.25 | 6.36 | 25.5 | 42.4 | 12.50 | 318.3 |
| Mean | 38.25 | 5.18 | 6.36 | 25.4 | 42.4 | 12.85 | 318.2 |
| LSD | 0.100 | 0.16 | NS | 0.22 | NS | NS | NS |
| | | | | | | | |
| Sorghum | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000W | GY |
| ICSV1002 | 38.3 | 4.34 | 4.87 | 25.1 | 43.1 | 13.4 | 329.7 |
| Local | 38.2 | 6.03 | 7.85 | 24.8 | 41.6 | 12.3 | 306.8 |
| Mean | 38.25 | 5.185 | 6.36 | 24.95 | 42.35 | 12.85 | 318.25 |
| LSD | NS | 0.16 | 0.12 | 0.22 | 0.55 | 0.85 | 3.48 |
| | | | | | | | |
| Varieties | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000W | GY |
| TGX1937-1F | 37.4 | 4.50 | 8.03 | 23.5 | 39.3 | 12.8 | 264.5 |
| TGX1986-2F | 38.4 | 4.47 | 5.93 | 24.4 | 43.3 | 12.8 | 322.1 |
| TGX1987-10F | 37.4 | 5.08 | 8.90 | 23.3 | 38.0 | 9.05 | 243.6 |
| TGX1990-45F | 37.4 | 4.40 | 7.63 | 24.3 | 40.3 | 11.5 | 313.1 |
| TGX1987-62F | 38.3 | 6.25 | 6.70 | 25.3 | 41.3 | 12.0 | 313.9 |
| TGX1987-96F | 37.4 | 5.38 | 7.63 | 24.2 | 38.1 | 9.97 | 311.7 |
| TGX1448-2E | 39.1 | 5.65 | 4.23 | 28.6 | 46.3 | 17.5 | 366.6 |
| TGX1835-10E | 38.6 | 5.88 | 5.27 | 25.4 | 43.1 | 13.5 | 339.1 |
| TGX1830-20E | 39.1 | 5.10 | 4.90 | 27.1 | 45.9 | 14.7 | 347.4 |
| TGX1019-2EB | 39.3 | 5.10 | 4.37 | 27.5 | 46.1 | 17.5 | 359.4 |
| Mean | 38.24 | 5.181 | 6.359 | 25.36 | 42.17 | 13.132 | 318.14 |
| LSD | 0.21 | 0.35 | 0.27 | 0.5 | 1.23 | 1.90 | 7.77 |
| | | | | | | | |
| *Striga* level | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000GW | GY |
| 0g | 0.00 | 0.00 | 0.00 | 26.60 | 44.3 | 13.40 | 361.9 |
| 2.5g | 57.4 | 6.97 | 8.51 | 25.10 | 42.5 | 12.90 | 311.0 |
| 5g | 57.3 | 8.57 | 10.50 | 24.40 | 40.3 | 12.20 | 281.8 |
| Mean | 57.35 | 7.77 | 9.505 | 24.75 | 41.4 | 12.55 | 296.4 |
| LSD | 0.12 | 0.19 | 0.15 | 0.27 | 0.67 | NS | 4.26 |

**1SSE:***Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height,**GW** Grain Weight,**GY** Grain yield

**Table 2: Combined Interaction effect of years, sorghum and soyabean varieties on sorghum.**

| Year | Sorghum | Varieties | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000GW | GY |
|---|---|---|---|---|---|---|---|---|---|
| 2013 | ICSV 1002 | TGX1937-1F | 37.50 | 3.53 | 6.40 | 24.10 | 39.30 | 9.660 | 280.50 |
| | | TGX1986-2F | 38.30 | 3.01 | 4.67 | 25.00 | 43.20 | 13.80 | 337.30 |
| | | TGX1987-10F | 37.40 | 3.73 | 6.87 | 23.90 | 42.00 | 10.10 | 260.70 |
| | | TGX1990-45F | 37.30 | 3.53 | 5.93 | 24.90 | 41.50 | 11.80 | 328.60 |
| | | TGX1987-62F | 38.30 | 3.27 | 5.40 | 25.20 | 43.20 | 12.30 | 327.00 |
| | | TGX1987-96F | 37.50 | 3.53 | 5.60 | 24.40 | 44.20 | 10.60 | 323.50 |
| | | TGX1448-2E | 38.40 | 1.40 | 3.20 | 28.70 | 41.50 | 19.00 | 383.10 |
| | | TGX1835-10E | 38.50 | 3.93 | 3.93 | 26.20 | 42.10 | 13.90 | 348.40 |
| | | TGX1830-20E | 38.80 | 2.33 | 3.67 | 27.20 | 45.40 | 15.10 | 346.00 |
| | | TGX1019-2EB | 39.30 | 2.00 | 3.07 | 27.50 | 43.00 | 21.10 | 359.70 |
| | Local | TGX1937-1F | 37.50 | 6.33 | 9.67 | 23.40 | 44.80 | 10.70 | 251.00 |
| | | TGX1986-2F | 38.50 | 5.13 | 7.20 | 23.90 | 42.50 | 11.70 | 308.90 |
| | | TGX1987-10F | 37.50 | 7.20 | 10.93 | 23.70 | 38.20 | 9.530 | 235.40 |
| | | TGX1990-45F | 37.50 | 5.87 | 9.33 | 24.30 | 39.10 | 11.60 | 302.20 |
| | | TGX1987-62F | 38.20 | 5.67 | 8.00 | 25.00 | 39.80 | 11.50 | 297.30 |
| | | TGX1987-96F | 37.30 | 6.13 | 9.67 | 23.90 | 36.30 | 10.30 | 303.50 |
| | | TGX1448-2E | 39.00 | 3.40 | 5.27 | 26.40 | 46.60 | 15.40 | 346.70 |
| | | TGX1835-10E | 38.40 | 4.33 | 6.60 | 24.60 | 43.10 | 12.70 | 328.80 |
| | | TGX1830-20E | 39.00 | 4.67 | 6.13 | 26.00 | 44.60 | 13.80 | 346.30 |
| | | TGX1019-2EB | 39.00 | 3.13 | 5.67 | 26.70 | 46.90 | 18.60 | 353.90 |
| 2014 | ICSV 1002 | TGX1937-1F | 37.30 | 4.93 | 6.40 | 23.90 | 37.60 | 9.490 | 274.20 |
| | | TGX1986-2F | 38.50 | 5.73 | 4.67 | 25.30 | 45.30 | 13.30 | 336.60 |
| | | TGX1987-10F | 37.30 | 5.73 | 6.87 | 23.50 | 37.00 | 8.760 | 245.90 |
| | | TGX1990-45F | 37.30 | 5.13 | 5.93 | 24.60 | 41.70 | 11.80 | 322.10 |
| | | TGX1987-62F | 38.40 | 6.46 | 5.46 | 26.00 | 42.30 | 12.50 | 332.90 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | TGX1987-96F | 37.30 | 4.67 | 5.60 | 24.70 | 39.10 | 9.900 | 321.10 |
| | TGX1448-2E | 39.60 | 6.87 | 3.20 | 30.60 | 50.30 | 19.00 | 383.40 |
| | TGX1835-10E | 38.70 | 5.93 | 3.93 | 26.20 | 45.70 | 14.10 | 351.40 |
| | TGX1830-20E | 39.50 | 5.40 | 3.67 | 28.50 | 47.70 | 15.70 | 359.60 |
| | TGX1019-2EB | 39.70 | 5.60 | 3.07 | 28.40 | 50.30 | 15.90 | 372.50 |
| Local | TGX1937-1F | 37.30 | 3.20 | 9.67 | 22.70 | 35.50 | 8.900 | 252.20 |
| | TGX1986-2F | 38.50 | 3.90 | 7.20 | 23.50 | 42.10 | 12.50 | 309.00 |
| | TGX1987-10F | 37.30 | 3.67 | 10.93 | 22.10 | 34.90 | 7.800 | 232.50 |
| | TGX1990-45F | 37.30 | 3.07 | 9.33 | 23.50 | 38.70 | 10.90 | 299.80 |
| | TGX1987-62F | 38.30 | 9.67 | 8.00 | 25.00 | 39.80 | 11.50 | 298.80 |
| | TGX1987-96F | 37.30 | 7.20 | 9.67 | 23.70 | 36.30 | 9.130 | 298.80 |
| | TGX1448-2E | 39.50 | 10.90 | 5.27 | 28.70 | 46.60 | 16.50 | 353.10 |
| | TGX1835-10E | 38.70 | 9.33 | 6.60 | 24.40 | 42.70 | 13.20 | 327.90 |
| | TGX1830-20E | 39.10 | 8.00 | 6.13 | 26.80 | 45.80 | 14.30 | 343.70 |
| | TGX1019-2EB | 39.40 | 9.67 | 5.67 | 27.30 | 47.80 | 14.50 | 351.60 |
| Mean | | 38.24 | 5.18 | 6.36 | 25.36 | 42.36 | 12.82 | 318.40 |
| LSD | | NS | 0.69 | NS | NS | 2.45 | NS | NS |

**1SSE:***Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height,**GW** Grain Weight,**GY** Grain yield

The combine analysis on effect of cowpea varieties screened in 2013 and 2014 were significantly ($p < 0.05$) different. *Striga* emergence was delayed in 2013 than 2014 (Table 3).

Fewer *Striga* count were recorded in 2014 throughout the samply period (6 and 8 WAS), while higher plant height was seen in 2013 at 6 and 8 WAS than 2014. Higher grain yield was recorded in 2013 than 2014 (Table 3).

The sorghum resistant variety ICSV 1002 significantly delayed *Striga* emergence, supported fewer *Striga* count at 6 and 8 WAS, produced taller plant height at 6 and 8 WAS and higher grain yield than local susceptible variety (Table 3)

The combine effect on cowpea varieties screened on sorghum shows that cowpea varieties IT04K-217-5 and IT04K-333-2 delayed *Striga* emergence compared to other varieties, fewer *Striga* count was recorded in cowpea variety IT04K-217-5 at 6 and 8 WAS (Table 3). Cowpea varieties IT04K-217-5 and IT07K-237-2-1 produced taller plant height at 6 and 8 WAS respectively compared to other varieties. Grain yield was higher in cowpea variety IT04K-339-1 compared to other varieties (Table 3).

Polybags with 2.5 g *Striga* innoculation delayed *Striga* emergence and supported fewer *Striga* count at 6 and 8 WAS than 0 and 5 g *Striga* inoculation. Plant height was taller at 0 g *Striga* level and higher grain yield was also observed at 0 g *Striga* level (Table 3).

The interaction effect of year, sorghum and cowpea varieties for 2013 and 2014 combined were not significantly ($p < 0.05$) different in all the parameters (Table 4)

**Table 3: 2013 and 2014 combine effect of cowpea varieties screened on sorghum**

| Year | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000GW | GY |
|---|---|---|---|---|---|---|---|
| 2013 | 38.10 | 4.48 | 6.58 | 25.70 | 45.50 | 20.60 | 438.60 |
| 2014 | 37.10 | 4.26 | 6.55 | 24.90 | 42.80 | 20.30 | 436.10 |
| Mean | 37.60 | 4.37 | 6.57 | 25.30 | 44.15 | 20.45 | 437.35 |
| LSD | 0.750 | 0.15 | 0.13 | 0.33 | 2.61 | 0.190 | 3.48 |
| | | | | | | | |
| Sorghum | 37.90 | 3.52 | 5.66 | 25.90 | 44.40 | 21.10 | 444.60 |
| ICSV 1002 | 37.10 | 5.22 | 7.46 | 24.60 | 43.00 | 20.10 | 430.00 |
| Local | 37.50 | 4.37 | 6.56 | 25.25 | 43.70 | 20.60 | 437.30 |
| LSD | 0.750 | 0.15 | 0.13 | 0.330 | 2.61 | 0.190 | 2.57 |
| | | | | | | | |
| Varieties | | | | | | | |
| IT04K-217-5 | 38.70 | 2.90 | 3.75 | 27.30 | 46.10 | 25.30 | 468.80 |
| IT04K-227-4 | 36.00 | 4.65 | 6.23 | 25.10 | 44.10 | 20.80 | 439.70 |
| IT07K-210-1 | 37.20 | 5.68 | 8.48 | 25.40 | 42.20 | 19.80 | 428.00 |
| IT07K-25-3-3 | 37.80 | 3.08 | 4.15 | 26.80 | 45.70 | 23.80 | 450.00 |
| IT07K-237-2-1 | 37.00 | 4.52 | 8.17 | 24.90 | 48.10 | 17.90 | 427.00 |
| IT04K-333-2 | 38.70 | 3.77 | 5.47 | 25.80 | 44.30 | 21.30 | 448.00 |
| IT04K-339-1 | 37.80 | 3.67 | 5.02 | 26.30 | 44.60 | 22.00 | 489.50 |
| IT04K-405-5 | 37.20 | 5.07 | 7.98 | 23.50 | 42.30 | 17.90 | 405.40 |
| IT07K-293-3 | 37.50 | 5.03 | 7.97 | 24.30 | 42.90 | 20.20 | 432.20 |
| IT07K-318-2 | 37.20 | 5.35 | 8.42 | 23.40 | 41.20 | 17.30 | 383.60 |
| Mean | 37.51 | 4.37 | 6.56 | 25.28 | 44.15 | 20.63 | 437.22 |
| LSD | 1.680 | 0.32 | 0.28 | 0.740 | 5.85 | 0.420 | 5.74 |
| | | | | | | | |
| *Striga* level | | | | | | | |
| 0g | 0.00 | 0.00 | 0.00 | 27.20 | 46.00 | 21.40 | 464.70 |
| 2.5g | 55.80 | 6.09 | 8.97 | 25.10 | 43.30 | 20.50 | 432.20 |
| 5g | 56.20 | 6.99 | 10.70 | 23.60 | 43.10 | 19.90 | 415.10 |
| Mean | 56.00 | 6.54 | 9.84 | 24.35 | 43.20 | 20.20 | 423.65 |
| LSD | 0.920 | 0.18 | 0.16 | 0.410 | 3.2 | 0.23 | 3.15 |

**1SSE:***Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height,**GW** Grain Weight,**GY** Grain yield

**Table 4: Combined Interaction effect of years, sorghum and cowpea varieties on sorghum.**

| Year | Sorghum | Variety | 1SSE | 6SSC | 8SSC | 6PH | 8PH | 1000GW | GY |
|---|---|---|---|---|---|---|---|---|---|
| 2013 | ICSV1002 | IT04K-217-5 | 41.90 | 3.20 | 3.33 | 27.50 | 46.90 | 25.70 | 482.00 |
| | | IT04K-227-4 | 37.60 | 4.20 | 5.33 | 27.20 | 45.20 | 21.30 | 444.60 |
| | | IT07K-210-1 | 37.60 | 4.53 | 7.73 | 26.30 | 43.50 | 20.90 | 439.80 |
| | | IT07K-25-3-3 | 38.10 | 3.27 | 3.07 | 27.40 | 46.40 | 24.40 | 454.50 |
| | | IT07K-237-2-1 | 37.30 | 3.47 | 7.07 | 26.30 | 43.10 | 19.40 | 425.00 |
| | | IT04K-333-2 | 38.40 | 3.60 | 5.00 | 26.10 | 44.90 | 21.70 | 456.60 |
| | | IT04K-339-1 | 38.20 | 3.20 | 4.20 | 26.60 | 45.70 | 22.50 | 492.50 |
| | | IT04K-405-5 | 37.70 | 4.27 | 7.00 | 24.90 | 45.40 | 18.90 | 420.30 |
| | | IT07K-293-3 | 38.00 | 4.33 | 6.87 | 25.00 | 43.70 | 20.70 | 433.70 |
| | | IT07K-318-2 | 37.70 | 4.27 | 7.27 | 24.30 | 43.40 | 18.10 | 400.50 |
| | Local | IT04K-217-5 | 41.20 | 3.87 | 4.33 | 26.60 | 44.90 | 24.50 | 456.60 |
| | | IT04K-227-4 | 36.60 | 5.40 | 7.20 | 23.60 | 44.50 | 20.80 | 432.80 |
| | | IT07K-210-1 | 37.10 | 6.40 | 9.27 | 25.30 | 43.10 | 20.30 | 422.50 |
| | | IT07K-25-3-3 | 37.50 | 4.00 | 5.33 | 26.50 | 44.30 | 23.30 | 446.50 |
| | | IT07K-237-2-1 | 36.90 | 5.53 | 9.27 | 25.10 | 68.30 | 17.60 | 436.10 |
| | | IT04K-333-2 | 41.00 | 4.60 | 6.07 | 25.70 | 44.30 | 20.90 | 437.30 |
| | | IT04K-339-1 | 37.40 | 4.80 | 5.80 | 25.90 | 43.70 | 21.70 | 478.20 |
| | | IT04K-405-5 | 37.10 | 5.47 | 9.00 | 24.40 | 42.60 | 17.80 | 401.70 |
| | | IT07K-293-3 | 37.20 | 5.40 | 9.00 | 24.20 | 43.70 | 19.90 | 433.00 |
| | | IT07K-318-2 | 37.10 | 5.87 | 9.40 | 24.90 | 42.90 | 17.40 | 381.70 |
| 2014 | ICSV 1002 | IT04K-217-5 | 34.80 | 1.47 | 3.20 | 28.30 | 47.40 | 26.40 | 482.50 |
| | | IT04K-227-4 | 37.30 | 3.73 | 5.27 | 25.80 | 44.50 | 20.90 | 450.30 |
| | | IT07K-210-1 | 37.30 | 4.40 | 7.67 | 25.80 | 42.80 | 19.30 | 429.90 |
| | | IT07K-25-3-3 | 38.70 | 1.73 | 3.00 | 27.50 | 47.10 | 24.30 | 462.10 |
| | | IT07K-237-2-1 | 37.30 | 3.07 | 7.13 | 24.70 | 41.50 | 17.70 | 427.40 |
| | | IT04K-333-2 | 38.70 | 2.66 | 4.87 | 26.40 | 45.20 | 21.70 | 463.80 |
| | | IT04K-339-1 | 38.70 | 2.60 | 4.13 | 27.10 | 45.70 | 22.70 | 504.80 |
| | | IT04K-405-5 | 37.30 | 4.07 | 6.93 | 23.10 | 41.90 | 17.80 | 406.70 |
| | | IT07K-293-3 | 37.90 | 4.00 | 6.80 | 24.90 | 43.50 | 20.40 | 437.50 |
| | | IT07K-318-2 | 37.30 | 4.40 | 7.40 | 23.30 | 40.30 | 17.20 | 382.10 |
| | Local | IT04K-217-5 | 36.70 | 3.07 | 4.13 | 26.80 | 45.10 | 24.30 | 456.10 |
| | | IT04K-227-4 | 36.00 | 5.27 | 7.13 | 23.90 | 42.10 | 20.20 | 431.20 |
| | | IT07K-210-1 | 36.70 | 7.40 | 9.27 | 24.30 | 39.50 | 18.80 | 419.80 |
| | | IT07K-25-3-3 | 37.00 | 3.33 | 5.20 | 25.80 | 44.90 | 23.30 | 440.50 |
| | | IT07K-237-2-1 | 36.70 | 6.00 | 9.20 | 23.30 | 39.30 | 17.00 | 420.10 |
| | | IT04K-333-2 | 36.70 | 4.27 | 5.93 | 24.90 | 42.70 | 20.80 | 434.30 |
| | | IT04K-339-1 | 36.90 | 4.07 | 5.93 | 25.50 | 43.20 | 21.00 | 484.40 |
| | | IT04K-405-5 | 36.70 | 6.47 | 9.00 | 21.50 | 39.50 | 17.00 | 393.10 |
| | | IT07K-293-3 | 36.80 | 6.40 | 9.20 | 23.10 | 40.80 | 19.70 | 425.00 |
| | | IT07K-318-2 | 36.70 | 6.87 | 9.60 | 21.20 | 38.20 | 16.40 | 370.10 |
| | Mean | | 37.60 | 4.37 | 6.56 | 25.28 | 44.14 | 20.62 | 437.44 |
| | LSD | | NS | NS | NS | NS | NS | NS | NS |

**1SSE:** *Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height, **GW** Grain Weight, **GY** Grain yield

The combined effect of year 2013 and 2014 were significantly ($p < 0.05$) different. *Striga* emergences were delayed in 2013 than 2014 (Table 5).

*Striga* count was fewer and plant height was taller at 6 WAS in 2014 while at 8 WAS taller heigh t was seen in 2013 (Table 5). Higher grain yield was recorded in 2013 than 2014 (Table 5).

Resistance sorghum variety ICSV 1002 significantly ($p < 0.05$) delayed *Striga* emergence, supported fewer *Striga* count at 6 WAS, produced taller plant height at 6 and 8 WAS and higher grain yield than susceptible local variety (Table 5).

The combined effect on groundnut varieties screened on sorghum shows that groundnut variety Chico delayed *Striga* emergence compared to other varieties (Table 5). Groundnut variety RMP-91 supported fewer *Striga* counts, produced taller plant height at 6 and 8 WAS and higher grain yield compared to other varieties (Table 5).

*Striga* innoculation at 2.5 g delayed *Striga* emergence and supported fewer *Striga* count than 0 and 5 g *Striga* level (Table 5). Taller plant height and higher grain yield was recorded in 0 g *Striga* level (Table 5).

The combined analysis for 2013 and 2014 interaction effect of year, sorghum and groundnut varieties screened were not significantly ($p < 0.05$) different in all the parameters except in 1000 GW (Table 6).

**Table 5: 2013 and 2014 combined effect of groundnut varieties screened on sorghum**

| Year | 1SSE | 6SSC | 6PH | 8PH | 1000GW | GY |
|---|---|---|---|---|---|---|
| 2013 | 37.49 | 5.16 | 23.85 | 44.16 | 31.19 | 463.72 |
| 2014 | 37.23 | 5.15 | 23.92 | 43.16 | 30.11 | 462.95 |
| Mean | 37.36 | 5.16 | 23.89 | 43.66 | 30.65 | 463.34 |
| LSD | 0.370 | 0.14 | 0.220 | 0.260 | 0.230 | 1.480 |
| Sorghum | | | | | | |
| ICSV 1002 | 38.04 | 4.77 | 24.61 | 44.67 | 30.88 | 468.48 |
| Local | 36.68 | 5.54 | 23.16 | 42.66 | 30.42 | 458.17 |
| LSD | 0.370 | 0.14 | 0.220 | 0.260 | 0.230 | 1.480 |
| Varieties | 1SSE | 6SSC | 6PH | 8PH | 1000GW | GY |
| TE3 | 37.73 | 4.18 | 24.18 | 44.70 | 31.55 | 490.82 |
| CHICO | 37.95 | 5.78 | 23.75 | 43.85 | 31.38 | 461.84 |
| KH 241D | 37.03 | 6.05 | 22.56 | 42.86 | 30.18 | 440.97 |
| QH 243C | 37.63 | 5.08 | 24.70 | 43.95 | 31.63 | 474.90 |
| CN 94C | 37.08 | 5.80 | 23.76 | 42.60 | 29.63 | 452.09 |
| RRB | 37.05 | 5.11 | 22.88 | 41.55 | 29.13 | 429.80 |
| RMP-12 | 37.65 | 4.00 | 25.06 | 45.13 | 31.32 | 487.82 |
| RMP-91 | 37.68 | 3.26 | 25.66 | 46.50 | 31.53 | 494.73 |
| Groundnut-23 | 36.78 | 5.45 | 24.33 | 43.96 | 32.35 | 469.88 |
| Groundnut-11 | 37.03 | 6.83 | 21.95 | 41.55 | 27.78 | 430.39 |
| Mean | 37.36 | 5.15 | 23.88 | 43.67 | 30.65 | 463.32 |
| LSD | 0.83 | 0.32 | 0.490 | 0.590 | 0.520 | 3.3200 |
| *Striga* level | | | | | | |
| 0g | 0.00 | 0.00 | 25.87 | 45.48 | 31.75 | 474.12 |
| 2.5g | 55.92 | 6.71 | 23.80 | 43.41 | 30.54 | 461.61 |
| 5g | 55.89 | 8.76 | 21.99 | 42.11 | 29.65 | 454.24 |
| Mean | 37.36 | 5.16 | 23.89 | 43.67 | 30.65 | 463.32 |
| LSD | 0.45 | 0.17 | 0.270 | 0.330 | 0.290 | 1.8200 |

**1SSE:***Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height,**GW** Grain Weight,**GY** Grain yield

**Table 6: Combined Interaction effect of years, sorghum and groundnut varieties on sorghum.**

| Year | Sorgum | Varieties | 1SSE | 6SSC | 6PH | 8PH | 1000GW | GY |
|---|---|---|---|---|---|---|---|---|
| 2013 | ICSV 1002 | TE3 | 38.53 | 4.00 | 24.33 | 46.06 | 32.33 | 497.75 |
| | | CHICO | 41.26 | 5.26 | 24.33 | 45.46 | 31.60 | 467.60 |
| | | KH 241D | 37.40 | 5.46 | 23.80 | 45.00 | 31.73 | 445.98 |
| | | QH 243C | 38.33 | 4.60 | 25.13 | 45.00 | 32.40 | 480.19 |
| | | CN 94C | 37.53 | 5.53 | 24.53 | 44.60 | 30.20 | 458.82 |
| | | RRB | 37.46 | 5.80 | 23.60 | 43.93 | 30.26 | 434.39 |
| | | RMP-12 | 38.40 | 3.80 | 25.13 | 46.40 | 32.06 | 494.84 |
| | | RMP-91 | 38.53 | 2.93 | 26.00 | 47.46 | 32.40 | 504.46 |
| | | Groundnut-23 | 37.40 | 5.00 | 25.00 | 45.46 | 32.26 | 472.85 |
| | | Groundnut-11 | 37.40 | 6.00 | 22.46 | 42.73 | 27.53 | 431.57 |
| | Local | TE3 | 37.06 | 4.73 | 23.53 | 44.06 | 31.06 | 485.10 |
| | | CHICO | 36.60 | 6.33 | 23.06 | 43.46 | 31.80 | 457.03 |
| | | KH 241D | 36.73 | 6.53 | 23.06 | 42.46 | 30.06 | 437.07 |
| | | QH 243C | 36.86 | 5.66 | 23.73 | 42.93 | 31.86 | 468.53 |
| | | CN 94C | 36.80 | 6.00 | 23.13 | 41.40 | 30.60 | 446.78 |
| | | RRB | 36.73 | 4.26 | 22.60 | 40.60 | 29.53 | 427.39 |
| | | RMP-12 | 36.86 | 4.40 | 23.86 | 44.53 | 31.66 | 480.50 |
| | | RMP-91 | 36.86 | 4.13 | 25.00 | 45.53 | 3.260 | 486.04 |
| | | Groundnut-23 | 36.40 | 5.73 | 23.80 | 43.80 | 32.73 | 467.33 |
| | | Groundnut-11 | 36.73 | 7.00 | 21.86 | 42.40 | 30.46 | 429.81 |
| 2014 | ICSV 1002 | TE3 | 38.66 | 3.46 | 25.26 | 45.46 | 31.93 | 496.77 |
| | | CHICO | 36.60 | 5.00 | 24.73 | 44.06 | 31.13 | 467.52 |
| | | KH 241D | 36.66 | 5.67 | 23.06 | 42.93 | 29.66 | 444.12 |
| | | QH 243C | 38.67 | 4.33 | 25.86 | 44.86 | 31.33 | 479.51 |
| | | CN 94C | 37.33 | 5.46 | 24.60 | 43.20 | 29.20 | 457.36 |
| | | RRB | 37.33 | 6.13 | 23.53 | 41.80 | 28.80 | 433.82 |
| | | RMP-12 | 38.67 | 3.13 | 26.46 | 46.00 | 31.26 | 495.23 |
| | | RMP-91 | 38.67 | 2.40 | 26.73 | 47.46 | 32.00 | 502.39 |
| | | Groundnut-23 | 37.33 | 4.80 | 25.20 | 44.33 | 32.46 | 472.85 |
| | | Groundnut-11 | 37.33 | 6.73 | 22.46 | 41.20 | 27.06 | 431.57 |
| | Local | TE3 | 36.66 | 4.53 | 23.60 | 43.20 | 30.86 | 483.66 |
| | | CHICO | 36.60 | 6.53 | 22.86 | 42.40 | 31.00 | 455.22 |
| | | KH 241D | 36.67 | 6.53 | 21.33 | 41.06 | 29.26 | 436.72 |
| | | QH 243C | 36.67 | 5.73 | 24.06 | 43.00 | 30.93 | 471.37 |
| | | CN 94C | 36.67 | 6.26 | 22.80 | 41.20 | 28.53 | 445.40 |
| | | RRB | 36.67 | 4.26 | 21.80 | 39.86 | 27.93 | 423.60 |
| | | RMP-12 | 36.67 | 4.66 | 24.80 | 43.60 | 30.26 | 480.71 |
| | | RMP-91 | 36.67 | 3.60 | 24.90 | 45.53 | 30.46 | 486.04 |
| | | Groundnut-23 | 36.00 | 6.26 | 23.33 | 42.26 | 31.93 | 466.50 |
| | | Groundnut-11 | 36.67 | 7.60 | 21.00 | 39.86 | 26.06 | 428.61 |
| | Mean | | 37.33 | 5.16 | 23.91 | 43.66 | 29.95 | 463.33 |
| | LSD | | NS | NS | NS | NS | 1.04 | NS |

**1SSE:** *Striga* shoot emergence, **SSC:** *Striga* shoot count, **PH:** Plant height, **GW:** Grain Weight, **GY:** Grain yield **NS**: Not significant

## DISCUSSION

### *Striga* Emergence

The delayed on *Striga* emergence in 2014 compared to 2013 experiment in sorghum sown in polybags with soyabean varieties could be due to depletion of the viable *Striga* seed and residual effect of the previous year (2013) treatments which slow down the *Striga* germination. The delay observed in 2013 compared to 2014 in cowpea and groundnut could be due to effect of climate especially rainfall variation which affect *Striga* plant.

The delayed in *Striga* emergence in ICSV1002 resistant variety compared to Local susceptible variety might be due to ability of the resistant variety to delay the release of the stimulant for *striga* seed germination. This is earlier observed by Gurney *et al.,* (2002) that resistant variety produce lower amounts of germination stimulants to their root exudates, leading to smaller number of attached parasite and/or later attachment of the parasite to the host.

The delayed in *Striga* emergence in soyabean variety TGX1019 – 2EB, cowpea varieties IT04K–217-5 and IT04K–333-2 and groundnut variety Chico might be attributed to the effectiveness of these trap crops varieties to stimulate suicidal germination in the *Striga* seeds and hindering the parasite radicle from attachment to the host. This is confirm by the work of Schulze *et al.,* (2003) that some varieties of cowpea, groundnut and soyabean have potential to cause suicidal germination of *S. hermonthica* and improve soil fertility.

The 2.5g *Striga* level delayed *striga* emergence compared to 5g in soyabean and groundnut varieties and in 5g *striga* level in cowpea could be attributed to interaction effect of many factors in the Polybags e.g. temperature and moisture which affected *Striga* plant and could not be fully understood.

### *Striga* Count

The higher *Striga* count in 2013 compared to 2014 in cowpea and groundnut variety could be due to the population of the *Striga* in the soil during first trial in 2013, which might have been depleted during 2014 trial. This is in agreement with the finding of De Groote *et al.,* 2010 that soyabean trigger suicidal germination of *Striga* and reduce *striga* seed bank in the soil. The higher *Striga* count in soyabean in 2014 might be due to environmental or climate factors which is not clearly understood.

The fewer *Striga* count in the resistant variety ICSV1002 compared to Local susceptible variety might be attributed to the production of lower amounts of germination stimulants to their root exudates, leading to smaller number of attached parasites as suggested by Gurney *et al.,* (2002) that the resistant variety produce lower amounts of germination stimulants to their root exudates, leading to smaller numbers of attached parasites and or later attachment of the parasites to the host (Gurney *et al.,* 2002).

The fewer *Striga* count in soyabean varieties TGX 1990 – 45F and TGX 1448 – 2E, cowpea variety IT04K – 217-5 and groundnut variety RMP-91 compared to other varieties might be attributed to the reduction in *Striga* germination and attachment due to stimulation of suicidal germination of *Striga* seeds. This is confirm by the findings of Berner *et al.,* (1996) as mention earlier that two legume varieties has been found to cause suicidal germination of *Striga* in screen house experiment.

The fewer *Striga* count in 2.5 g *Striga* level compared to 5 g *Striga* level is attributed to the *Striga* population density, the 2.5 g *Striga* level produce fewer *Striga* than the 5 g *Striga* level which have more *Striga* seed density as suggested by Magani *et al.,* (1994) that fewer *Striga seed* density affect the *Striga* emergence and resulting in taller plant and higher grain yield.

**Plant Height**

The taller plant height in 2014 in soyabean could be attributed to increase in photosynthetic activity as well as reduction in competition for growth resources as a result of fewer *Striga* emergence and attachment compared to 2013. This confirm the work of Press *et al.,* (1989) that possible reduction in photosynthetic activity as well as competition for growth resources could lead to reduced plant height and yield while the taller plant height in 2013 in cowpea and groundnut compared to 2014 might be due to high level of tolerance of the host which determine the amount of resources potentially available for the parasite. This could not be fully understood.

The taller plant height in ICSV1002 resistant variety compared to Local susceptible variety could be attributed to the low stimulant production which results in fewer *Striga* plant and better sorghum establishment and growth. This is in agreement with the finding of Rodenburg *et al*., (2006) that in *Striga* infested areas cultivation with resistance crops results in fewer *Striga* plants and higher crop yield than a non-resistance genotype.

The taller plant height in soyabean variety TGX-1448 -2E, cowpea variety IT04K-217-5 and IT07K–237–2-1 and groundnut variety RMP – 91 compared to other varieties might be attributed to effectiveness of this varieties to stimulate *Striga* seed suicidal germination, reduces *Striga* emergence and attachment an giving the sorghum plant a good head start and development resulting into taller height. This is in agreement with the work of De Groote *et al*., (2010) that soyabean triggers suicidal germination of *Striga* and reduces the S*triga* seed bank in the soil.

The taller plant height in 0 g *Striga* level (control) could be attributed to lack of *Striga* seed or innoculation in the bags hence no *Striga* activities, giving the plant free and full access to growth resources without competition. This is in agreement with the finding of Ayongwa *et al*., (2010) that *Striga* competes for water and nutrients as a result crop growth is stunted and yield is generally reduced.

**Grain yield**

The higher grain yield in 2013 compared to 2014 might be due to micro-climate environment in the polybags which affects the behavior and growth of the sorghum plant, it is not clearly understood but the performance in height could ultimately contribute to the high yield.

The high yield in the ICSV1002 resistant variety compared to Local susceptible could be attributed to the ability of the variety to reduce or inhibit *Striga* activity which allow for better growth and development hence translated into high yield. This in agreement with the finding of Rodenburg *et al*., (2006) that in *Striga* infested areas cultivated with resistance crops results in fewer *Striga* plants and higher crop yield than a non-resistance genotype.

The high grain yield in soyabean variety TGX- 1448 -2E, cowpea varieties IT 04K-217-5 and IT04K – 339-1 and groundnut varieties Groundnut – 23 and RMP – 91 compared to other varieties might be due to the effectiveness of this varieties in reducing *Striga* impact and enabling better plant performance which resulted in higher yield.

The high yield in O g *Striga* level compared to 2.5 g and 5 g could be attributed to free *Striga* environment and lack of growth resource competition hence good and better plant growth and yield. This is suggested by Press *et al.,* (1989) that reduction in photosynthetic activity as well as competition for growth resources could also lead to reduced plant height and yield.

**Conclusion and Recommendations**

The results of the study demonstrate that soyabean variety TGX 1448-2E polybags gave the best performance as it supported fewer striga count, produced taller plant height and highest grain yield compared to other varieties. Polybags with cowpea variety IT04K-217-5 gave the best performance compared to other varieties as it recorded fewer striga count and produced taller plant height compared to other varieties. The polybag with groundnut variety RMP-91 recorded fewer count, highest plant height and higher grain yield compared to others. This shows that integrating the above varieties could help in reducing the capacity of increasing the striga seed bank. Therefore, the soyabean variety TGX 1448-2E, cowpea variety IT04K-217-5 and groundnut variety RMP-91 are recommended as best varieties for use to control striga under intercropping system.

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